

WHAT IS CLAIMED IS:

1. A front teleconverter lens system having three lenses or more, and an afocal magnification, upon attaching to an imaging lens, of 1.4 or more, and forming an afocal optical system;

the front teleconverter lens system comprising, in order from an object;

a first lens group having positive refractive power; and

a second lens group having negative refractive power;

a diffractive optical surface being arranged in at least one of the first lens group and the second lens group; and

wherein the following conditional expression is satisfied:

$$1.2 < \phi F / \phi R < 10$$

where  $\phi F$  denotes the effective diameter of the most object side lens surface of the first lens group, and  $\phi R$  denotes the effective diameter of the most image side lens surface of the second lens group.

2. The front teleconverter lens system according to claim 1, wherein

the first lens group includes at least one pair of a convex surface and a concave surface adjacent with each other and the following conditional expression is satisfied:

$$-3.0 < |Pd| / Ps < -0.05$$

where  $Ps$  denotes a combined refractive power of the convex

surface and the concave surface of the pair, and  $P_d$  denotes a refractive power of the diffractive optical surface.

3. The front teleconverter lens system according to claim 2,  
5 wherein

the pair of a convex surface and a concave surface adjacent with each other have an air space there between.

4. The front teleconverter lens system according to claim 3,  
10 wherein

an incident angle of the principal ray passing through the maximum image height to the diffractive optical surface is 15 degrees or less.

5. The front teleconverter lens system according to claim 4,  
15 wherein

the first lens group has a biconvex lens and at least one negative lens, and

the second lens group has a biconcave lens at the most image  
20 side, and wherein

the following conditional expression is satisfied:

$$0.03 < \phi R / f_d < 1.0$$

where  $f_d$  denotes the focal length of a lens on which the diffractive optical surface is formed.

6. The front teleconverter lens system according to claim 5,  
wherein

the diffractive optical surface is arranged on one of the lens  
5 surfaces in the first lens group, and the following conditional expression is  
satisfied:

$$1.0 < fF/DFR < 10.0$$

where  $fF$  denotes the focal length of the first lens group, and  
DFR denotes a distance along the optical axis between the first lens group  
10 and the second lens group.

7. The front teleconverter lens system according to claim 6,  
wherein

the following conditional expression is satisfied:

15  $1.0 < fd/L < 10.0$

where  $fd$  denotes the focal length of a lens on which the  
diffractive optical surface is formed, and  $L$  denotes a distance between the  
most object side lens surface of the first lens group and the most image  
side lens surface of the second lens group.

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8. The front teleconverter lens system according to claim 2,  
wherein

the pair of a convex surface and a concave surface adjacent with  
each other form a single cemented surface.

9. The front teleconverter lens system according to claim 8,  
wherein

an incident angle of the principal ray passing through the  
5 maximum image height to the diffractive optical surface is 15 degrees or  
less.

10. The front teleconverter lens system according to claim 9,  
wherein

10 the first lens group has a biconvex lens and at least one negative  
lens, and

the second lens group has a biconcave lens at the most image  
side, and wherein

the following conditional expression is satisfied:

15 
$$0.03 < \phi R / f_d < 1.0$$

where  $f_d$  denotes the focal length of a lens on which the  
diffractive optical surface is formed.

11. The front teleconverter lens system according to claim 10,  
20 wherein

the diffractive optical surface is arranged on one of the lens  
surface in the first lens group, and

the following conditional expression is satisfied:

$$1.0 < f_F / DFR < 10.0$$

where  $f_F$  denotes the focal length of the first lens group, and DFR denotes a distance along the optical axis between the first lens group and the second lens group.

5                    12.    The front teleconverter lens system according to claim 11,  
wherein

the following conditional expression is satisfied:

$$1.0 < f_d/L < 10.0$$

10                    where  $f_d$  denotes the focal length of a lens on which the  
diffractive optical surface is formed, and L denotes a distance between the  
most object side lens surface of the first lens group and the most image  
side lens surface of the second lens group.

15                    13.    The front teleconverter lens system according to claim 2,  
wherein

an incident angle of the principal ray passing through the  
maximum image height to the diffractive optical surface is 15 degrees or  
less.

20                    14.    The front teleconverter lens system according to claim 2,  
wherein

the first lens group has a biconvex lens and at least one negative  
lens, and

25                    the second lens group has a biconcave lens at the most image  
side, and wherein

the following conditional expression is satisfied:

$$0.03 < \phi R / f_d < 1.0$$

where  $f_d$  denotes the focal length of a lens on which the diffractive optical surface is formed.

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15. The front teleconverter lens system according to claim 2, wherein

the diffractive optical surface is arranged on one of the lens surface in the first lens group, and the following conditional expression is  
10 satisfied:

$$1.0 < fF / DFR < 10.0$$

where  $fF$  denotes the focal length of the first lens group, and DFR denotes a distance along the optical axis between the first lens group and the second lens group.

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16. The front teleconverter lens system according to claim 2, wherein

the following conditional expression is satisfied:

$$1.0 < f_d / L < 10.0$$

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where  $f_d$  denotes the focal length of a lens on which the diffractive optical surface is formed, and  $L$  denotes a distance between the most object side lens surface of the first lens group and the most image side lens surface of the second lens group.

17. The front teleconverter lens system according to claim 1,  
wherein

an incident angle of the principal ray passing through the  
maximum image height to the diffractive optical surface is 15 degrees or  
5 less.

18. The front teleconverter lens system according to claim 17,  
wherein

the first lens group has a biconvex lens and at least one negative  
10 lens, and

the second lens group has a biconcave lens at the most image  
side, and wherein

the following conditional expression is satisfied:

$$0.03 < \phi R / f_d < 1.0$$

15 where  $f_d$  denotes the focal length of a lens on which the  
diffractive optical surface is formed.

19. The front teleconverter lens system according to claim 18,  
wherein

20 the diffractive optical surface is arranged on one of the lens  
surface in the first lens group, and the following conditional expression is  
satisfied:

$$1.0 < fF / DFR < 10.0$$

where  $fF$  denotes the focal length of the first lens group, and

DFR denotes a distance along the optical axis between the first lens group and the second lens group.

20. The front teleconverter lens system according to claim 17,  
5 wherein

the diffractive optical surface is arranged on one of the lens surface in the first lens group, and the following conditional expression is satisfied:

$$1.0 < fF/DFR < 10.0$$

10 where  $fF$  denotes the focal length of the first lens group, and DFR denotes a distance along the optical axis between the first lens group and the second lens group.

21. The front teleconverter lens system according to claim 17,  
15 wherein

the following conditional expression is satisfied:

$$1.0 < fd/L < 10.0$$

where  $fd$  denotes the focal length of a lens on which the diffractive optical surface is formed, and  $L$  denotes a distance between the  
20 most object side lens surface of the first lens group and the most image side lens surface of the second lens group.

22. The front teleconverter lens system according to claim 1,  
wherein



the first lens group has a biconvex lens and at least one negative lens, and

the second lens group has a biconcave lens at the most image side, and wherein

5 the following conditional expression is satisfied:

$$0.03 < \phi R / f_d < 1.0$$

where  $f_d$  denotes the focal length of a lens on which the diffractive optical surface is formed.

10 23. The front teleconverter lens system according to claim 22, wherein

the diffractive optical surface is arranged on one of the lens surface in the first lens group, and the following conditional expression is satisfied:

15  $1.0 < fF / DFR < 10.0$

where  $fF$  denotes the focal length of the first lens group, and DFR denotes a distance along the optical axis between the first lens group and the second lens group.

20 24. The front teleconverter lens system according to claim 22, wherein

the following conditional expression is satisfied:

$$1.0 < f_d / L < 10.0$$

where  $f_d$  denotes the focal length of a lens on which the

diffractive optical surface is formed, and L denotes a distance between the most object side lens surface of the first lens group and the most image side lens surface of the second lens group.

5                    25.    The front teleconverter lens system according to claim 1, wherein

the diffractive optical surface is arranged on one of the lens surface in the first lens group, and the following conditional expression is satisfied:

10                    
$$1.0 < fF/DFR < 10.0$$

where fF denotes the focal length of the first lens group, and DFR denotes a distance along the optical axis between the first lens group and the second lens group.

15                    26.    The front teleconverter lens system according to claim 1, wherein

the following conditional expression is satisfied:

$$1.0 < fd/L < 10.0$$

20                    where fd denotes the focal length of a lens on which the diffractive optical surface is formed, and L denotes a distance between the most object side lens surface of the first lens group and the most image side lens surface of the second lens group.

25                    27.    A front teleconverter lens system having three lenses or more, and an afocal magnification, upon attaching to an imaging lens, of

1.4 or more, and forming an afocal optical system;

the front teleconverter lens system comprising, in order from an object;

a first lens group having positive refractive power; and

5 a second lens group having negative refractive power;

a diffractive optical surface being arranged in at least one of the first lens group and the second lens group;

the first lens group comprising at least one pair of a convex surface and a concave surface adjacent with each other; and

10 the following conditional expression being satisfied:

$$-3.0 < |P_d| / P_s < -0.05$$

where  $P_s$  denotes a combined refractive power of the convex surface and the concave surface of the pair, and  $P_d$  denotes a refractive power of the diffractive optical surface.

15